Focus Group on Water Well Siting and Design - Syllabus

Discussion Topics:

1. Depth of Annular Surface Seal
2. Sealing-off Strata
3. Inter-Aquifer Seals
4. Setbacks
5. Floodproofing a Wellhead

Introduction

The annular surface seal, the sealing of poor-quality strata, inter-aquifer seals, setbacks, floodproofing a wellhead, and other surface construction features (e.g., openings, air vents, backflow prevention, etc.) all contribute toward preventing the well structure from allowing:

- the entry of contaminated surface water to usable groundwater, and
- the mixing of poor-quality groundwater with usable groundwater.

Each of these components of the well structure has vulnerabilities and can fail. To achieve an acceptable level of risk, all of the components work together as a protective system, with each component adding redundancy.

1. Depth of Annular Surface Seal

Background

Combined Bulletin 74-81 & 74-90 *Section 9.A Minimum Depth of Annular Surface Seal* specifies different minimum seal depths for water wells ranging from 20 to 50 feet, depending on the intended use of the well (irrigation, domestic, public supply, industrial, etc). These minimum seal depths were developed based on existing "customs and practices" and "industry consensus" (letter from Edwin A. Ritchie to John DeLucchi, dated May 11, 1982). However, it was acknowledged that the optimal depth for the annular surface seal was not known and that the minimum standards were "somewhat arbitrary."

Notwithstanding *Section 13 Sealing-off Strata*, the Bulletin implicitly allows,

depending on subsurface conditions, the annular space between the bottom of the annular surface seal and the first screened interval to be filled with non-sealing material (e.g., gravel). *Section 23 Requirements for Destroying Wells* allows the annular space between the bottom of the annular surface seal and the first screened interval to be filled with non-sealing material (e.g., gravel). In both of these sections, the Standards assume that groundwater quality is known.

The current Standards do not take into consideration potential future changes in hydrogeologic conditions such water quality degradation or variation in groundwater levels due to seasonal and long-term natural processes or anthropogenic activities.

Questions

1. Can we do better than "somewhat arbitrary" "customs and practices" for annular surface seal lengths?
2. What would an annular surface seal depth based on geology look like?
3. CCDEH/CGA comments recommend a single fixed minimum annular surface seal depth of 50 ft regardless of hydrogeologic conditions and intended well use. This recognizes that the mechanism for contamination is the same, no matter the intended use of the well. If one single depth is applied, what should the depth be?
4. What are the advantages and disadvantages of requiring that the annular surface seal be extended from the ground surface to the top of the uppermost screen interval (minus gravel reservoir + transition seal, as needed)?

2. Sealing-off Strata

Background

In *Section 13, Sealing-off Strata*, the term "strata" is used interchangeably with "aquifer." The current Standards do not define "strata," but give the following definition of "aquifer:"

> **Aquifer**. A geologic formation, group of formations or part of a formation that is water bearing and which transmits water in sufficient quantity to supply springs and pumping wells.

Combined Bulletin 74-81 & 74-90 *Section 13. Sealing-off Strata* states:

> "In areas where a well penetrates more than one aquifer, and one or more of the aquifers contains water that, if allowed to mix in sufficient quantity, will result in a significant deterioration of the quality of water in the other aquifer(s) or the quality of water produced, the strata producing such poor-quality water shall be sealed off to prevent entrance of the water into the well or its migration to other aquifer(s)."

The current Standards further specify that a seal be placed opposite the entirety of the poor-quality aquifer plus at least 10 feet into the confining layers. Placement of such a seal serves to:

- Prevent migration of poor-quality water to another aquifer via the annular space
- Add protection from poor-quality water entering a compromised well casing (e.g., due to corrosion)
- Improve eventual well destruction

Improved well destruction is thought to be achieved by placing the seal during construction directly in the annular space as opposed to perforating the blank casing and pushing sealant through the perforation into the annular space during destruction.

The current Standards do not describe or prescribe the scope of efforts to identify aquifers of poor-quality water. In practice, such data are typically not collected.

Questions

1. How can it be assured that existing undesirable groundwater quality is being identified to support decisions about sealing off strata as required by the current Standards (i.e., what are the available tools and techniques and what is a reasonable level of effort)?
2. Are the efforts described in response to above Question 1 reasonable and practical for all water wells (e.g., municipal, domestic, industrial, and agricultural)?
3. What should be the course of action in the absence of sufficient water quality information?

3. Inter-Aquifer Seals

Background

The current Standards do not include provisions for inter-aquifer seals. Inter-aquifer seals are placed against confining layers between aquifers. The purpose of inter-aquifer seals is to:

- Improve eventual well destruction of a single casing well with multiple screened sections, as explained above in the second to last paragraph in *Sealing-off Strata Background*
- Facilitate partial well destruction to maintain water quality objectives at the well head
- Prevent the exchange of water between aquifers (e.g., in the case of a nested monitoring wells with multiple casings in one borehole that monitor different distinct aquifers)

Inter-aquifer seals do not prevent the exchange of water between aquifers through wells with screens in more than one aquifer.

Questions

1. For protecting aquifers from future contamination, is it a best practice to separate adjacent aquifers (of known or unknown water quality) with inter-aquifer seals?
2. What current well logging practices can be used to consistently identify aquifers as defined in Bulletin 74 (see Terminology)?
3. Can inter-aquifer seals be required for the protection of the aquifer in a way that is consistent and enforceable?

4. Setbacks

Background

Combined Bulletin 74-81 & 74-90 *Section 8.A Separation* states (emphasis added):

> "All water wells shall be located an **adequate** horizontal distance from known or potential sources of pollution and contamination. Such sources include, but are not limited to…"

The Bulletin specifies numerical minimum horizontal separation distances (i.e.,

setbacks) between water wells and known or potential sources of pollution or contamination as follows:

Potential Pollution or Contamination Source	Minimum Horizontal Separation Distance Between Well and Known or Potential Source
Any sewer (sanitary, industrial, or storm; main or lateral)	50 feet
Watertight septic tank or subsurface sewage leaching field	100 feet
Cesspool or seepage pit	150 feet
Animal or fowl enclosure	100 feet

In this context, the Bulletin states that these horizontal separation distances (emphasis added):

> "… are generally considered **adequate** where a significant layer of unsaturated, unconsolidated sediment less permeable than sand is encountered between ground surface and groundwater. These distances are based on present knowledge and past experience. Local conditions may require greater separation distances to ensure groundwater quality protection."

The Bulletin does not explain what "adequate" means. This has caused confusion, including a false sense of security that the Standards ensure the safety of the well's end user. For example, California Department of Health Services (2006, p. 13) states:

> "The Department of Water Resources (DWR) has developed statewide construction standards for all new wells in California that provide adequate safety for public water supply wells."

However, the Standards were not developed with the goal of ensuring safe drinking water. The long-standing interpretation of the law is that DWR is responsible for establishing standards for well construction, maintenance,

abandonment, and destruction to prevent the well structure from allowing:

- the entry of contaminated surface water to usable groundwater, and
- the mixing of poor-quality groundwater with usable groundwater.

Setbacks, as presently specified in the Standards, may at once be ineffective and excessively restrictive:

- There are many pollution sources that are not included in the list.
- Setbacks do not include non-point pollution sources.
- Vertical separation is as least as critical as lateral separation for the purpose of reducing the risk of a contaminant reaching a well intake.
- The Standards state that LEA's may approve lesser setback distances, but this is not applied consistently.

Questions

1. Are minimum separation distances an important aspect of the well system for protecting the aquifer from contamination via the well structure? How?
2. If important, can the empirically-based minimum separation distances in Bulletin 74 be improved?
   A. Keep as-is?
   B. Revise/expand list of pollutant point-sources?
   C. Revise horizontal distances?
   D. Different setbacks for different water wells (e.g., public water supply wells vs. agricultural irrigation wells)?
3. As an alternative to the empirically-based setbacks in Bulletin 74, what would a standard for site-specific setbacks look like?
   A. What is the scope of the analysis?
   B. Who does the analysis?
   C. Does the analysis come with a "warranty" or "certification?" What is the extent of the "warranty?"
   D. Does LEA review/approve the analysis?

5. Floodproofing a Wellhead

Background

Combined Bulletin 74-81 & 74-90 *Section 8.C. Flooding and Drainage* states:

> "If possible, a well should be located outside areas of flooding. The top of the well casing shall terminate above grade and above known levels of flooding caused by drainage or runoff from surrounding land. For community water supply wells, this level is defined as the:
>
> > "...floodplain of a 100 year flood..." or above "...any recorded high tide...", (Section 64417, Sitting Requirements, Title 22 of the California Code of Regulations.)
>
> If compliance with the casing height requirement for community water supply wells and other water wells is not practical, the enforcing agency shall require alternate means of protection.
>
> Surface drainage from areas near the well shall be directed away from the well. If necessary, the area around the well shall be built up so that drainage moves away from the well."

In many places, Combined Bulletin 74-81 & 74-90 refers to non-specific "known flood levels" or "areas of flooding."

Questions

1. Should all wells be protected from flooding at the same level as community water supply wells (e.g., 100-year)?
2. How do we deal with areas below mean sea level such as exist in the Sacramento-San Joaquin River Delta?
3. Should the Standards specify "alternate means of protection?" What are they?

Terminology

Annular Seal [1] An interval of low permeability in the annular space constructed by placing approved materials. The primary purpose of the annular seal is minimizing vertical flow in the annular space. Secondary purposes of the annular seal include: protecting casing against corrosion or degradation, ensuring structural integrity of the casing, and stabilizing the borehole.

Annular Surface Seal [1] The uppermost annular seal that extends from essentially ground surface to a depth prescribed in the Standards.

Annular Space [2] The space between two well casings or between the casing and the wall of the drilled hole.

Aquifer [2] A geologic formation, group of formations or part of a formation that is water bearing and which transmits water in sufficient quantity to supply springs and pumping wells.

Surface Seal [1] The annular seal that extends over the length of the conductor casing between the outside of the conductor casing and the borehole wall.

Transition Seal [1] A seal placed between the top of the gravel pack and the bottom of the interval to be sealed for the purpose of preventing sealing material from infiltrating the gravel pack.

Notes

[1] DWR working definition

[2] Appendix A of the combined ADA-compliant Standard provided to the TAC

Reading Material

Prepare for the Focus Group meetings by reviewing the Essential Reading Materials below.

Essential and Optional Reading Materials listed below are provided in the shared file folder at https://cadwr.box.com/s/6vl5zi31atgkhpvd65n5zxu8phbgfco4

Essential Reading Material

DWR Combined Bulletin 74-81/90 (web-based document):
Water Wells, Sections 8, 9, 10, and 13

DDW Minimum Horizontal Distances Form

Supplemental Figures for Focus Group on Water Well Siting & Design

JDSUPRA.com article: "Supreme Court of California Weighs In on Blanket Categorization of Well Construction Permit Approvals as Ministerial" September 2, 2020 (Summary of POWER v Stanislaus County Court Decision)

Optional Reading Material

Ed Ritchie & DeLucchi Correspondence re: Basis of Annular Seal Depths in Bulletin 74

CDHS. 2006. Initial Statement of Reasons Waterworks Standards Title 22 CCR. California Department of Health Services. November 9, 2006.

Protecting our Water and Environmental Resources (POWER) et al. vs. County of Stanislaus. California Supreme Court decision. August 27, 2020.

Letter to Monterey County board of supervisors regarding amendments to chapter 15.08 of the Monterey County Code. December 22, 2020.